Building the LA County MATSim Model for the Analysis of Shared Mobility Modes

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Outline

1) Introduction (Caroline)
2) MATSim overview (Ihab)
3) Building the LA model (Huajun/Ihab)
4) How to access and run the model yourself! (Ihab/Huajun)
MATSim Overview

MATSim = Multi-Agent Transport Simulation

Key features:

- **Agent-based**: Simulates vehicle and individuals in household context
- **Dynamic**: Entire day, traffic congestion, attributes of drivers and passengers
- **Activity-based**: Travel demand based on individual activity patterns
- **Multi-modal**: Cars, public transit, bicycles, demand responsive transit, ...
- Allows for **large-scale** simulations (city, region)
- **Modular** approach: Several extensions (taxis, MaaS, congestion pricing, ...)
- **Open-source** ([https://github.com/matsim-org](https://github.com/matsim-org)) + Active community
MATSim Community

- Active community: regular developer and user meetings
- (Main) developers: TU Berlin, ETH Zürich, Senozon, ... and several others
- Software developed, maintained and extended for more than 10 years
- Several applications world wide

For more information, see www.matsim.org
- MATSim Book
- Tutorials
- User Guide
- Q&A
- Community pages
- ...
MATSim: How it works

Plan Modification / Plan Selection

Iterative Approach: Physical and Cognitive

Plan Scoring

Input

Output

Network, Public transit schedule, ...

Daily plans, person attributes, ...

Home (dep: 06:43)
trip (car)

Work (dep: 16:04)
trip (car)

Shopping (dep: 18:04)
trip (car)

Home

Home (dep: 12:42)
trip (bike)

Shopping (dep: 14:05)
trip (bike)

Home
Build the LA County MATSim model
Network Generation

MATSim Converter
- OpenStreetMap data
- Zone based parking cost data
- Transit GTFS

LA County (Higher Resolution)
- LA SCAG MATSim Network with network attributes
- Transit Vehicle Fleets with Transit Schedules
- LA DOT GTFS
- LA Metro GTFS
- Metrolink GTFS
- LA GO GTFS

The rest SCAG region (Lower Resolution)
Road Network
Population Activity Generation

MATSim Converter
- SCAG ABM Disaggregated Trips/Household/Person Info
- SCAG Freight ODs
- SCAG Tier1/Tier2 Transportation Analysis Zones

Persons with daily activity chain and inter-activity travel modes

LA-SCAG MATSim Population (Travel Demand)

Trucks trips

MATSim Converter
- Plan selected: yes
  - Activity: home_36600, x=219308.77924934198, y=-492202.6918447277
    - End time: 06:15:00
  - Leg: car, travel time: 00:14:01
  - Activity: work_34200, x=217258.84632072653, y=-481509.10106846545
    - End time: 11:57:20
  - Leg: car, travel time: 00:13:50
  - Activity: eatout_2400, x=216306.4814485427, y=-479166.1510645319
    - Max duration: 00:36:30
  - Leg: car, travel time: 00:15:56
  - Activity: home_36600, x=219308.77924934198, y=-492202.6918447277

Duration: 00:36:30

Home 06:15:00

Work 11:57:20

Eatout Duration: 00:36:30
Person Attributes

- Taken from the person / household data in the SCAG abm
- For person-specific policy investigations
- For income-dependent utility parameters
  - income above average → marginal utility of money < 1.0
  - income = average → marginal utility of money = 1.0 (1 $ = 1 utility unit)
  - income below average → marginal utility of money > 1.0

```
<person id="10000099">
  <attributes>
    <attribute name="ESR" class="java.lang.String">0</attribute>
    <attribute name="age" class="java.lang.String">3</attribute>
    <attribute name="eduatt" class="java.lang.String">1</attribute>
    <attribute name="gender" class="java.lang.String">male</attribute>
    <attribute name="hhinc" class="java.lang.String">22700</attribute>
    <attribute name="hnumautos" class="java.lang.String">1</attribute>
    <attribute name="hhsiz" class="java.lang.String">3</attribute>
    <attribute name="householdId" class="java.lang.String">3247023</attribute>
    <attribute name="htype" class="java.lang.String">Multiple</attribute>
    <attribute name="marginalUtilityOfMoney" class="java.lang.Double">4.673641850220264</attribute>
    <attribute name="race" class="java.lang.String">NHAS</attribute>
    <attribute name="schg" class="java.lang.String">0</attribute>
    <attribute name="subpopulation" class="java.lang.String">person</attribute>
    <attribute name="ten" class="java.lang.String">3</attribute>
    <attribute name="wkind20" class="java.lang.String">0</attribute>
    <attribute name="woccc24" class="java.lang.String">0</attribute>
    <attribute name="worker" class="java.lang.String">unemployed</attribute>
  </attributes>
```
1. Model overview

<table>
<thead>
<tr>
<th>%</th>
<th># of household</th>
<th># of agents</th>
<th># of trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original SCAG ABM Model</td>
<td>6,180,962</td>
<td>18,682,684</td>
<td>71,126,268</td>
</tr>
<tr>
<td>1%</td>
<td>183,307</td>
<td>186,637</td>
<td>708,219</td>
</tr>
<tr>
<td>5%</td>
<td>857,668</td>
<td>934,398</td>
<td>3,552,392</td>
</tr>
<tr>
<td>10%</td>
<td>1,582,433</td>
<td>1,867,724</td>
<td>7,104,799</td>
</tr>
<tr>
<td>25%</td>
<td>3,191,734</td>
<td>4,669,729</td>
<td>17,770,662</td>
</tr>
<tr>
<td>100%</td>
<td>6,180,962</td>
<td>18,682,684</td>
<td>71,126,268</td>
</tr>
</tbody>
</table>

2. Supported Modes

- **Base case:** Car, Public Transit, Ride, Bike, Freight, Walk, Ride_taxi, Ride_schoolbus
- **Scenario case:** Ride-Hailing
  - Single and multi passenger
  - Automated and Non-automated
  - Fares
Model Calibration: Mode Share

- Transport users’ choice dimensions:
  ● Route choice
  ● Mode choice
  ● Departure time choice

- Adjusted parameters:
  ● Alternative-specific constants
  ● Marginal disutility of traveling
  ● Daily utility constants
Model calibration: Link volumes

- Link volumes at certain count stations are calibrated towards “ground truth” values.
- We use several volume count data sources, including
  
  ● SCAG screenline data (Blue dots)
    ○ Mainly on local roads
    ○ Total stations: 72
  
  ● PEMS freeway count station data (The rest dots)
    ○ Mainly on freeways
    ○ Total stations: 445

Background Map: OpenStreetMap
Visualization of Simulated Activities

- blue = home
- red = work
- yellow = leisure/shopping
- green = education
Visualization of Simulated Vehicles
Visualization of Public Transit Vehicles
Run the model yourself!

https://github.com/matsim-scenarios/matsim-los-angeles

1) Download the project
2) Execute the runnable jar file (double click or “java -jar matsim-los-angeles-v1.1-jar-with-dependencies.jar”)
3) GUI: Choose a configuration file from ./scenarios/los-angeles-v1.1/input/... and “Start MATSim”

Or clone the project and run the JAVA run class from your IDE.
Outlook

- Multi-modal policy investigations + detailed analysis (person-specific, spatial and temporal high resolution)
- Autonomous ride-hailing services in the West Side Cities Area (MATSim extensions: dvrp, av, drt)
- Road pricing concepts (MATSim extensions: roadPricing, decongestion)
- Submitted SGC proposal to add one-way carsharing with BlueLA user data to explore concepts for planned expansion
- Submitted UC SB 1 proposal to use LA County MATSIM model to simulate contact human frequency, duration, and intensity patterns for a COVID-19 virus infection dynamic model with USC’s School of Medicine
Thank you!

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